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WORKPIECE HOLDING MECHANISM FOR A PLANE POLISHING DEVICE

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Claim

1. A workpiece holding mechanism for a plane polishing device characterized in that it contains a holding part, which holds a workpiece that is on top of the polishing surface of the plane polishing device and is equipped with a convex spherical surface centering around one point on the surface of the said workpiece to be processed; a support part, which is provided for maintaining a constant orientation and is equipped with a concave spherical surface, which engages with the aforementioned convex spherical surface in a freely oscillating manner centering about one point on the aforementioned workpiece; and a flexible body, which is provided between the aforementioned holding part and the aforementioned supporting part and has high torsional rigidity but can bend freely.

Detailed explanation of the invention

Industrial application field

The present invention concerns a workpiece holding mechanism for a plane polishing device. In particular, it concerns a holding mechanism for a workpiece in a plane polishing device which polishes the surface of thin plates.

Prior art

Generally, a workpiece holding mechanism for a plane polishing device is constructed to include a holding area, where the workpiece is held on top of a polishing surface of the plane polishing device, and the surface of the workpiece is polished by oscillating [vibrating while moving] the workpiece over the polishing surface.

Figure 2 is a longitudinal section of a workpiece holding mechanism for a plane polishing device of the prior art. In Figure 2, a disk (1) of the plane polishing device is rotated about a shaft (2). Also, a sleeve (4) is attached to a frame (3) of the plane polishing device in a freely rotatable manner, and a splined shaft (5) is attached to the central hole of this sleeve (4) in a freely movable manner in the direction of the shaft and in such a manner that it rotates together with the sleeve (4) about the shaft. A lever (7), which is attached to an air cylinder (6) provided for the frame (3), engages with the splined shaft (5) in a freely rotatable manner. Also, a gear (9), which is attached to a motor (8) provided for the frame (3), engages with a gear (10), which is provided at the sleeve (4).

A hemispherical body (11) engages with the curved area in the form of a spherical surface that is provided at the front end of the splined shaft (5) in a freely oscillating manner. A pressing plate (12) is fixed to the hemispherical body (11), and a frame (13) is provided at the pressing plate (12). A pin (14), which is provided at the frame (13), engages with a groove (15), which is provided at the front end of the splined shaft (5). A compression spring (16), which is provided between the splined shaft (5) and the frame (13), interacts to press the hemispherical body (11) onto the splined shaft (5) in order to prevent the hemispherical body (11) from falling when the splined shaft (5) ascends.

A through-hole (17), which is provided at the pressing plate (12), and a through-hole (18), which is provided between the hemispherical body (11) and the pressing plate (12), are connected to a vacuum pump (not shown) through a pipe (19), which passes through a hole provided at the splined shaft (31), in order to vacuum hold material (20), which is a magnetic disk forming the workpiece, onto the pressing plate (12). A ring (21) is also provided and fixed at the pressing plate (12) in order to determine the position of the material (20).

To polish the surface of the material (20) with this plane polishing device, the air cylinder (6) is actuated so that the pressing plate (12) ascends and so that the material (20) is vacuum held against the inner side of the ring (21) at the lower surface of the pressing plate (12). Next, the pressing plate (12) is lowered by the air cylinder (6) through rotation of the motor (8), and the material (20) is pressed against the polishing surface (22) of the disk (1). Also, a polishing solution (not shown) is spread over the polishing surface (22). Accordingly,

the bottom surface of the material (20) is polished by the action of its own rotations and vibrations by the rotation of the disk (1).

The polishing surface (22) of the disk (1) is processed to have a flat surface; however, a small amount of waviness remains in many actual cases. Accordingly, it is necessary for the material (20) and the pressing plate (12) to be able to tilt slightly along the waviness of the polishing surface (22) in order for the material (20) constantly to adhere close to the polishing surface (22) for a smooth finish. This tilting is obtained when the hemispherical body (11) vibrates with the spherical concave area of the splined shaft (5). Moreover, the material (20) tilts while centering around the center C because the center C of the spherical surface of the hemispherical body (11) is established to be positioned at the bottom surface of the material (20), and the position of the bottom surface of the material (20) does not change even though it is tilted, and polishing can occur.

The pipe (19) is elastic and can absorb some tilting in the hemispherical body (11). Also, the hemispherical body (11) vibrates around the splined shaft (5); therefore, it is designed so that the rotation by the motor (8) is transmitted to the pressing plate (12) and the material (20) when the pin (14) engages with the groove (15).

Problems to be solved by the invention

However, the ability of the pressing plate (12) and material (20) to follow the waviness of the polishing surface (22) was not satisfactory. One factor is the generation of a large amount of

friction between the pin (14) and the groove (15). Figure 3 is a schematic diagram explaining the force that is applied to the pin (14), and it corresponds to the right side surface diagram of the major part in Figure 2. In Figure 3, force b, which is equal to the friction between the material (20) and the polishing surface (22), is applied to the groove (15) from the pin (14) when the splined shaft (5) rotates, as illustrated by arrow a. Furthermore, since a condition is created, in which the right side opens between the material (20) and the polishing surface (22), as illustrated in Figure 1, by the waviness of the polishing surface (22), and if force P is obtained by the piston (6), force P interacts upwards at the left edge of the material (20). To consider the equilibrium of the moment about center C, where the length between center C of the spherical surface of the hemispherical body (11) and the left edge of the material (20) is d and the height between center C and the pin (14) is h, a force of Pd/h is also applied to the pin (14). In practice, this force P becomes considerably large; therefore, a large force also acts on the pin (14), resulting in a large frictional force.

There was also the problem of the pin (14) being constantly pressed toward the left by the groove (15) in Figure 3, causing the pressing plate (12) to swing around the pin (14) according to the waviness of the polishing surface (22), the base ([illegible]) of the pin (14) to change its position to the left or the right relative to the splined shaft (5), and a fluctuation to occur in the rotation of the pressing plate (12).

The aim of the present invention is to offer a workpiece holding mechanism for a plane polishing device in which the aforementioned problems are solved, there is a satisfactory following of the waviness of the polishing surface by tilting of

the workpiece, and the fluctuation in the rotation of the workpiece is reduced for a smooth polishing of the workpiece.

Means to solve the problems

The present invention comprises a holding part (34), which holds the workpiece that is on top of the polishing surface of the plane polishing device and is equipped with a convex spherical surface centering around one point on the surface of the said workpiece to be processed; a support part (32), which is provided for maintaining a constant orientation and is equipped with a concave spherical surface, which engages with the aforementioned convex spherical face in a freely vibrating manner centering about one point on the aforementioned workpiece; and a flexible body (36), which is provided between the aforementioned holding part (34) and the aforementioned support part (32) and has high torsion rigidity but can bend freely.

Function

The elastic body (36), which has torsional rigidity but can bend freely, tilts the holding part (34) against the support part (32) while following the waviness of the polishing surface and not generating a large amount of friction. During this process, the holding part (34) does not separate from the support part (32) in the direction of rotation.

Application example

Next, an application example of the present invention will be explained with reference to a figure. Figure 3 [sic; 1] is a longitudinal section of an application example of the present invention. A disk (1), shaft (2), frame (3), sleeve (4), air cylinder (6), lever (7), motor (8), and gears (9) and (10) are the same as those illustrated in Figure 1 [sic; 2]. A splined shaft (31) is attached to the sleeve (4) so that it can freely oscillate in the direction of the shaft and rotate together with it around the shaft. A hemispherical body (33) engages with the concave part in the form of a spherical surface, which is provided at a flange (32) at the lower end of the splined shaft (31) in a freely oscillating manner. A pressing plate (34) is fixed to the hemispherical body (33). A through-hole (35) of the pressing plate (34) is connected to a pipe (19) in order to hold the material (20) against the pressing plate (34).

The upper end of bellows (36) is fixed to the flange (32) and its lower end to the pressing plate (34). The torsional rigidity of the bellows (36) with respect to the central shaft is high, but it can expand and bend in the direction of the central shaft; therefore, the pressing plate (34) does not separate from the flange (32) in the direction of rotation, but it can tilt freely. Accordingly, a large frictional force is not generated even when the pressing plate (34) is tilted, and the pressing plate (12) and the material (20) satisfactorily follow the waviness of the polishing surface.

The present invention can also be applied to plane polishing devices, in which the disk is fixed, and the pressing plate (34),

for example, rotates together with the frame (3) around the shaft (12).

A steel ball, for example, may also be included between the concave spherical surface of the supporting part and the convex spherical surface of the holding part so that the friction can be reduced.

Furthermore, the elastic body that is provided between the support part and the holding part does not necessarily have the form of a bellows. For example, dividing the bellows in the circumferential direction, in other words, several plate springs that are bent in the middle and arranged over the circumference may also be used.

Effect of the invention

As explained above, in the workpiece holding mechanism for a plane polishing device of the present invention, the holding part is tilted without the generation of a large amount of friction between the groove and the pin by using an elastic body which has torsional rigidity but which can expand and bend freely, instead of an engagement between the groove and the pin, and the workpiece can satisfactorily tilt with and follow the waviness of the polishing surface.

Also, oscillations around the pin are eliminated when the support part is tilted, a fluctuation in the rotating speed of the workpiece can be made very small, and the effect is smooth polishing of the workpiece.

Brief description of the figures

Figure 1 is a longitudinal section of an application example of the present invention. Figure 2 is a longitudinal section of an example of a workpiece holding mechanism for a plane polishing device of the prior art. Figure 3 is a model diagram which explains the force which interacts on the pin (14) as an example illustrated in Figure 2.

1···disk, 5, 31···splined shaft, 11, 33···hemispherical body, 12, 34···pressing plate, 14···pin, 15···groove, 20···material, and 36···bellows.

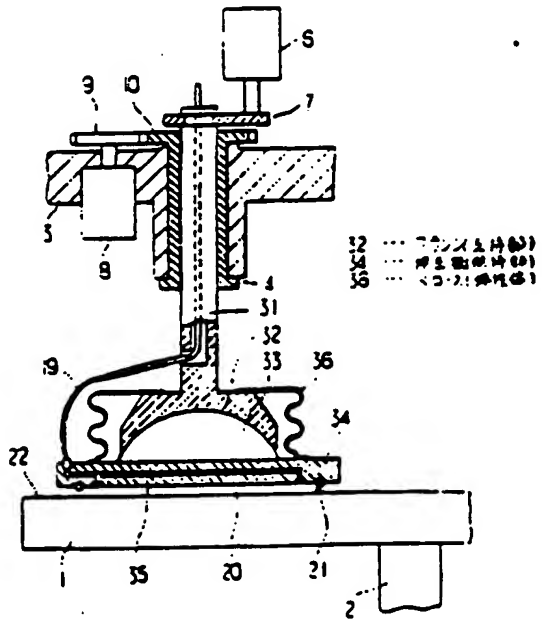

Figure 1

Key: 32 Flange (supporting part)
34 Pressing plate (holding part)
36 Bellows (elastic body)

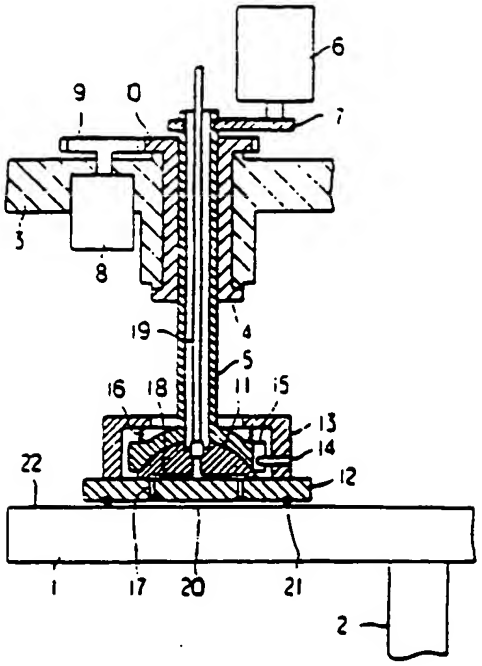

Figure 2

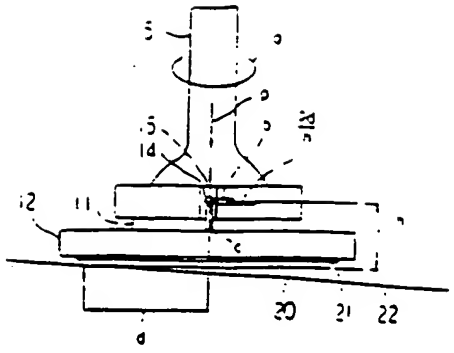

Figure 3

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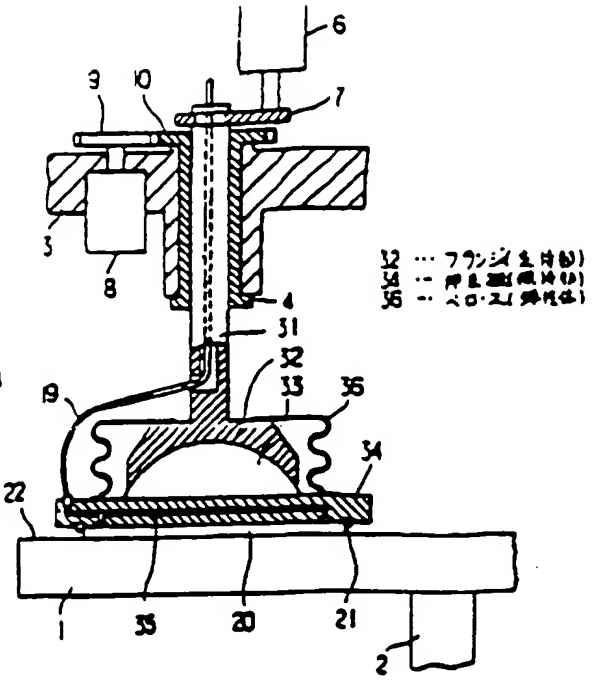
TITLE : WORK HOLDING MECHANISM FOR SURFACE POLISHING MACHINE



ABSTRACT : PURPOSE:To polish a work smoothly by providing a resilient bellows between the work holding section having convex face and the supporting member having concave face engagable slidably with the convex face.
CONSTITUTION:Semi-spherical body 33 secured to a pressboard 34 i engaged slidably with spherical recess made in the lower end flange 32 of spline shaft 31 to adsorb a material 20 through a hole 35 communicated with a tube 19 to the pressboard 34. A bellows 36 having high rigidity in the rotary direction while flexible against the vertical shrinkage and bending is secured between said flange 32 and the pressboard 34. Consequently, the work 20 or the pressboard 34 will follow the waving of the polishing face 22 well to reduce the fluctuation of the rotary speed of the work 20 thus to polish the work 20 smoothly.

⑲ 日本国特許庁（JP）　　⑪ 特許出願公開

⑫ 公開特許公報（A）　　昭61－25768

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⑤発明の名称　平面研磨装置の被加工物保持機構

②特　願　昭59－145408

②出　願　昭59(1984) 7月13日

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明細書

1. 発明の名称

平面研磨装置の被加工物保持機構

2. 特許請求の範囲

(1) 平面研磨装置の研磨盤上の被加工物を保持しこの被加工物の被加工面上の一点を中心とする凸球面を有する保持部と、荷重を一定に保つて取付けられ前記被加工物上の一点を中心とし前記凸球面に摺動自在に係合する凹球面を有する支持部と、前記保持部と前記支持部の間に設けられ回りに対しては剛性が大きく曲げに対しては柔軟な弾性体とを有することを特徴とする平面研磨装置の被加工物保持機構。

3. 発明の詳細な説明

〔産業上の利用分野〕

本発明は、平面研磨装置の被加工物保持機構、特に精度の高い研磨をするための平面研磨装置の被加工物保持機構に関する。

〔従来技術〕

一般に平面研磨装置の被加工物保持機構は、平面研磨装置の研磨盤上の被加工物を保持する保持部を含んで構成され、研磨盤上において被加工物を摺動させて被加工物の表面を研磨している。

第2図は、従来の平面研磨装置の被加工物保持機構の断面図である。第2図において平面研磨装置の円盤1は軸2を中心として回転させられる。一方平面研磨装置のフレーム3にはスリーブ4が摺動自在に取り付けられ、このスリーブ4の中心にはスプライン軸5が軸方向には摺動自在に回りにはスリーブ4と一体となつて回転するように取り付けられている。フレーム3に設けられたエアシリンダ6に取り付けられたレバー7は [illegible] に荷重を加えている。[illegible] に設けたレバー7はスリーブ4に [illegible] 軸受10と組み合つている。

スプライン軸5の [illegible] 保持体11が [illegible] 結合している。保持体11に被加工物12が保持され、被加工物12には [illegible] が設けられている。 [illegible] に設けられた [illegible] 14は、スプライン軸5の先端部に設けた [illegible] 15に結合している。

スプライン軸5と軸11の間に設けられた圧縮ばね16は中間体11をスプライン軸5に押し付けるように作用し、スリーブ軸5が上昇したときに中間体11が落下するのを防止している。

押圧板12に設けられた通気孔17及び中間体11と押圧板12の間に設けられた通気孔18は、スプライン軸31に設けた穴を通る管19を介して真空ポンプ（図示省略）に連結され、被加工物である眼鏡レンズの素材20を押圧板12に真空吸着するためのものである。また素材20の位置を決めるために押圧板12にリング21が固設されている。

この平面研磨装置で素材20に曲面を研磨するには、エアシリンダ8を作動させて押圧板12を上昇させ、素材20を押圧板12の下面のリング21の内側に真空吸着させる。次にモータ8により回転させながら押圧板12をエアシリンダ8により下降させ素材20を円盤1の研磨面22に押し付ける。また図には示してないが研磨面22には、研磨液が供給されている。従って素材20の下面は、自からの回転及び円盤1の回転による運動で研磨される。

円盤1の研磨面22は、平面になるように作られているが実際には僅かであるがうねりが発生している場合が多い。従って素材20を研磨面22に常に密着させて滑らかに研磨するには、素材20及び押圧板12を研磨面22のうねりに従って多少傾くことができるようにする必要がある。この傾きは、中間体11のスプライン軸5の軸方向の遊びとの関係で得られ、しかも中間体11の球面の中心が素材20の下面に位置するように設定されているので素材20は中心Cを中心として傾き、傾いても素材20の下面の位置は変化せずに研磨することができる。

なお管19は柔軟性を有し中間体11の多少の傾きは自由である。また中間体11がスプライン軸5に対し摺動するため、ピン14と溝15の係合により押圧板12及び素材20までモータ8による回転が伝わるようにしている。

（発明が解決しようとする問題点）

しかし、押圧板12及び素材20の研磨面22のうねりに対する追従性はあまりよくなかった。この原因の一つはピン14と溝15の間に大きな摩擦力が生じるためである。第3図は、ピン14に作用する力を説明するための説明図で、第1図の主要部の要部拡大に相当する。第3図の矢視aに示すようにスプライン軸5が傾斜していれば素材20と研磨面22との摩擦力に向かう力fがピン14により溝15に加えられる。さらに研磨面22のうねりにより素材20と研磨面22との間に第1図に示すように角度θが働く状態になったとし、ピストン6により力Pが与えられるとすると素材20の表面に上向きに力Pが働く。中間体11の球面の中心Cと素材20の底面までの寸法をd、中心Cからピン14までの距離をhとし、中心Cのまわりのモーメントの釣合を考えるとピン14には $\frac{Pd}{h}$ の力も作用する。角度によっては力Pがかなり大きくなるためピン14にも大きな力が作用し大きな摩擦力が生じていた。

また、第3図においてピン14は溝15により常に円周方向に押されることとなり研磨面22のうねりに従って押圧板12はピン14を中心として回り傾かせることとなり、スプライン軸5に対して傾斜的にピン14の角度はα方向に変位し、押圧板12の回転に変動が生じることとなるという欠点があった。

本発明の目的は、上記欠点を除去し、被加工物の傾きの研磨皿のうねりに対する追従性がよく、また被加工物の回転変動を少くして円滑に被加工物を研磨することが可能な平面研磨装置の被加工物保持機構を提供することにある。

（問題点を解決するための手段）

本発明は、平面研磨装置の研磨皿上の被加工物を保持しこの被加工物の被加工面上の一点を中心とする凸球面を有する保持部材34と、保持部を一定に従って設けられ前記被加工物上の一点を中心とし前記凸球面に摺動自在に嵌合する凹球面を有する支持部材32と、前記保持部材34と前記支持部材32との間に設けられねじりに対しては剛性が大きく傾きに対しては柔軟な弾性体とを有するものである。

（作用）

ねじりに対しては剛性を有し傾けに対しては柔軟な弾性体は保持部材34を支持部材32に対し研磨皿のうねりに追従させてできる復元力を生じることなく、傾動させる。この保持部材34は支持部材32に

対し回転方向にはずれない。

（実施例）

次に本発明の実施例について図面を参照して説明する。第3図は本発明の一実施例の縦断面図である。円盤1、軸2、フレーム3、スリーブ4、エアシリンダ6、レバー7、モータ8、歯車9,10は第1図に示すものと同じである。スプライン軸31は、軸方向には摺動自在に軸回りに一体となって回転するようにスリーブ4に取り付けられている。スプライン軸31の下端のフランジ32に設けた球面状の凹部に半球体33が摺動自在に係合している。半球体33に押圧板34が固着されている。押圧板34の貫通孔35は管19と連結され素材20を押圧板34に吸着するためのものである。

ベローズ36が上端をフランジ32に固着し下端を押圧板34に固着して設けられている。ベローズ36は中心軸回りのねじりに対しては剛性が大きいのに対し、中心軸方向の伸縮及び曲げに対しては柔軟であるため、押圧板34はフランジ32に対し回転方向にはずれないが、しかも自由に傾くことができる。従って押圧板34が傾くときも大きな摩擦力は生じず押圧板12及び素材20の研磨面のうねりに対する追従性はよい。

なお本発明は、円盤が固定してあってフレーム3とともに押圧板34等が軸12を中心として旋回するような平面研磨装置にも適用できる。

また支持部の凹球面と保持部の凸球面の間に潤滑剤を介在させて、摩擦力を減少させることもできる。

さらに支持部と保持部との間に設ける弾性体は、必ずしもベローズの形状をしている必要はない。例えばベローズを周方向に分割したもの、言い換えれば中間を切断させた複数の板ばねを円周上に並べたものでもよい。

（発明の効果）

本発明の平面研磨装置の被加工物保持機構は、以上説明したように軸とピンの係合の代わりにねじりには剛性を有し伸縮及び曲げに対して柔軟性のある弾性体を使用することにより、軸とピンとの間の大きな摩擦力を発生させることなく保持部が傾き、研磨面のうねりに対する被加工物の傾きの追従性をよくすることができる。

また保持部が傾くときにピンを中心として回動することがなくなり被加工物の研磨速度の変動を非常に小さくすることができ、円滑に被加工物を研磨できる効果がある。

4.図面の簡単な説明

第1図は本発明の一実施例の縦断面図、第2図は平面研磨装置の被加工物保持機構の従来の一例の縦断面図、第3図は第2図に示す一例のピン16に作用する力を説明するための模式図である。

1……円盤、5,31……スプライン軸、11,33……半球体、12,34……押圧板、14……ピン、15……孔、20……素材、36……ベローズ。

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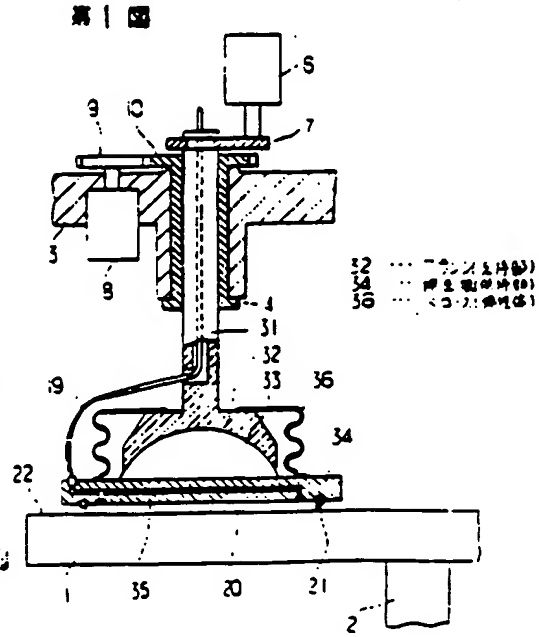
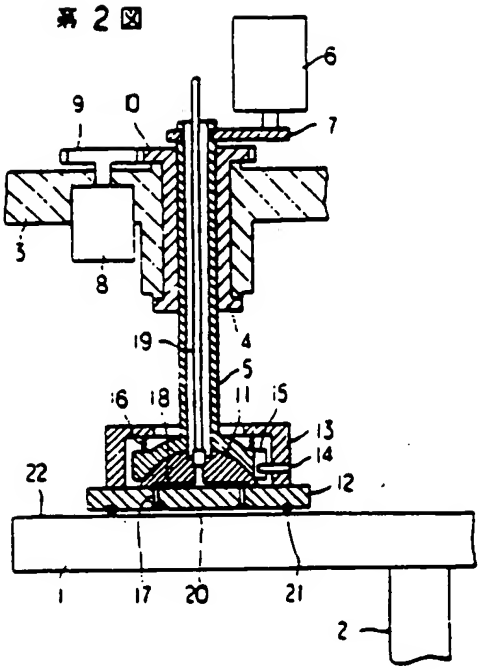
代理人　弁理士　内　原　晋

第1図



第2図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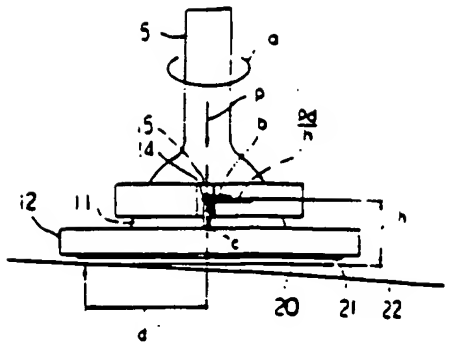
第3図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